

Application No. 09/681,108

## REMARKS

The FINAL Office Action of September 9, 2004 has been carefully considered. Reconsideration of this application, as amended, is respectfully requested.

Claims 2-5, 7-9, 12-15, 17-19, and 21-26 are pending in this application. Of these, claims 2, 12, and 21 are independent claims. An Amendment mailed May 6, 2004 amended claims 2, 4-5, 7-9, 12, 14-15, and 17-19, canceled claims 1, 6, 10, 11, 16, and 20 and added claims 21-26.

In the specification, this Amendment corrects typographical errors in paragraph 0037 in which the incorrect reference numbers in Figure 8 were cited. Additional amendments to the specification were made to overcome the objections set forth in the Office Action discussed below.

In the claims, this Amendment amends claims 2, 4, 12, 14, 21, 24, and 26 as discussed in more detail below to overcome objections and rejection thereto in the Office Action. In addition, Applicant amends claims 2 and 12 to clarify their meaning by removing an ambiguity by deleting "the one of the plurality of", to correctly set forth that color channels of sampled values are used to compute the coefficients of the linear transformation. Also, Applicant amends claim 17 to clarify the form of the claim.

No new matter is believed to be introduced by these amendments.

### 1. Response to Claim/Specification Objections

Sections 11-13, on pages 5-6, of the Office Action, object to claims 4, 14, 24 and 26 and similar informalities in the specification. More specifically, in the claims and throughout the specification the following changes were made to respond to the objections:

(a) the claims 4 and 14 and the specification (paragraphs 0047, and 0056) were amended so that variables in the form  $b'_b$  are written in the form  $b_b$ ;

(b) the claims 4 and 14 and the specification (paragraphs 0045, 0046, 0047, 0048, 0049, 0053, 0055, 0056, 0059, 0084, 0085, and 0087) were amended to

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avoid confusion of the use of the simultaneous reference of "b" denoting both a coefficient of an equation and the blue color channel by replacing the use of the coefficient "b" with the coefficient "h";

(c) the claims 24 and 26 were amended to avoid the reading of item (b) as though there are windows of two color channels.

Accordingly the objections to the claims and specification are believed to be overcome.

## 2. Response to Claim Rejections Under 35 USC 112

Sections 14-18, on pages 6-7, of the Office Action, rejects claims 2, 4, 12, and 14 under 35 USC 112, second paragraph, as being indefinite. In response thereto Applicant amends claims 2 and 12 to remove the term "such" (and similarly amends claim 21 to clarify analogous language therein), claim 12 to remove the term "image recording module", and claims 4 and 14 to define the variables  $y$ ,  $x$ ,  $R()$ ,  $B()$ , and  $G()$ . Support for the amendments to claims 4 and 14 are set forth in Applicant's specification at paragraphs 0040 and 0047.

Accordingly, the rejection under 35 USC 112, second paragraph, of claims 2, 4, 12, and 14 is believed to be overcome.

## 3. Response to Claim Rejections Under 35 USC 103

The Office Action on pages 7-14, sections 19-36, rejects claims 2-3, 5, 7-9, 12-13, 15, 17-19, 21-22, 24 and 26 under 35 USC 103(a) as being unpatentable over Adams, entitled "Interactions Between Color Plane Interpolation and other Image Processing Functions in Electronic Photography", published in SPIE, Vol. 2416, pp. 144-151, 1995 (hereinafter referred to as "Adams"), in view of Kirk, U.S. Patent No. 4,803,548 (hereinafter referred to as Kirk).

Applicant respectfully traverses and request reconsideration for the reasons set forth below. For the purpose of discussion below claim 12 is referred to as the representative independent claim of independent claims 1, 12 and 21.

As set forth in discussion related to Adams in the Office Action mailed May 6,

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2004, which is incorporated herein by reference, Adams describes methods for determining non-sampled values of color filtered arrays. The Office Action acknowledges that the CFA methods taught by Adams fail to satisfy the following limitations of Applicant's independent claim 12:

(a) the Office Action on page 4, lines 11-12, acknowledges that "coefficients of the bilinear interpolation [proposed by Adams in section 3.3] are *not* computed using ones [ ] color channels of sample values of pixels in the image"; and

(b) the Office Action on pages 8-9, paragraph 23, acknowledges that "Adams does *not* [ ] expressly show or suggest: (12.b.) Computing coefficients of a linear transformation using [ ] color channels of sampled values of pixels in the image without interpolating values of other color channels of pixels that were not recorded in the image".

Further, Applicant submits that when claim 12 is considered as a whole (i.e., elements 12.b and 12.c together) the combination of Adams with Kirk fail to disclose or suggest using a linear transformation, computed using color channels of sampled values of pixels in the image without interpolating values of other color channels (element 12.b), to estimate a color channel of a selected pixel not recorded at the location of the selected pixel in the image (element 12.c).

Generally, Kirk discloses a method for enhancing a video image with a luminance signal (L) and two chromaticity signals (I, Q), where the luminance signal defines the luminance component of the image at a greater resolution than the chromaticity signals. In one example, the chromaticity signal I is generated at 1/4 and the chromaticity signal Q is generated at 1/9 the resolution of the luminance signal L. (See Kirk column 3, lines 49-59.)

Unlike Applicant's invention recited in claim 12 which records an image of sampled values output from a color filter array where pixels in the image have a location at which a sampled value of one of a plurality of color channels is recorded (element 12.a, e.g., one RGB sample), Kirk's method for enhancing a video image relies on samples of all three LIQ samples at each pixel location. As set forth in Kirk in column 3, lines 60-62, while referring to Figure 1: "Fig. 1 illustrates by reference numeral 1 a subsidiary region of 4x4 image pixels 2. Each of these pixels has a value of L, I and Q associated with it."

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More specifically, Kirk's method for enhancing LIQ samples at each pixel location in an image begins by "applying a local averaging process of subsidiary regions within [a] selected region to reduce the luminance information to the same spatial resolution as the chromaticity information" (see Kirk column 2, lines 40-44, and Kirk column 4, lines 4-12). Next Kirk uses regression analysis to define a linear relationship (with two linear equations) between the average values for luminance (L) and the average values for chromaticity (I,Q), respectively (see Kirk column 2, lines 25-33 and column 4, lines 13-25). Depending on the fit of the two linear equations to the data, a chromatic value is determined for each luminance pixel using coefficients of the defined linear relationship (see Kirk column 4, lines 32-44).

Unlike Kirk which image enhancement method operates using a complete set of LIQ samples at each pixel location with spatially varying resolution between samples, Adams' image reconstruction method operates using a CFA sampled image which is an incomplete set of RGB samples at each pixel location but with spatially consistent resolution. Further as discussed above, Kirk's method for image enhancement requires (as a result of operating using a complete set of LIQ signals with spatially varying resolution) the application of a local averaging process to reduce the LIQ samples to the same spatial resolution (see Kirk column 2, lines 40-44, and Kirk column 4, lines 4-12).

In contrast, Applicant's claimed method for reconstructing CFA images does not require such local averaging to be performed before carrying out linear regression analysis to estimate non-sampled color channels of pixels. Thus, combining Kirk, which requires a full set of LIQ samples at each pixel to enhance chromatic signals sampled at a lower spatial resolution, with Adams fails to disclose or suggest Applicant's invention set forth in claim 12. Instead the logical combination of Kirk and Adams would be sequential: first, the method of Adams would be used to reconstruct the color planes of a CFA image and subsequently the method of Kirk would be used to enhance a bandwidth reduced transmission of the CFA reconstructed image.

Accordingly, Applicant respectfully submits that independent claim 12 is patentably distinguishable over Adams taken singly or in combination with Kirk as their combination fails to disclose or suggest reconstructing a CFA image with a linear transformation that is used to estimate a color channel of a selected pixel of

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an image not recorded at the location of the selected pixel, where coefficients of the linear transformation are estimated with the sampled color channel values of pixels without interpolating the non-sampled color channel values of the pixels.

In addition, it should be noted that independent claims 1 and 21 contain very similar limitations to those discussed above with respect to claim 12, and therefore the argument presented above with regard to claim 12 applies equally to independent claims 1 and 21.

Insofar as claims 3, 5, 7-9, 13, 15, 17-19, 22, 24 and 26 are concerned, these claims depend from one of now presumably allowable independent claims 1, 12, and 21 and are also believed to be in allowable condition.

#### 4. Response to Dependent Claim Rejection Under 35 USC 103

The Office Action on pages 14-15, sections 37-39, rejects claims 4 and 14 under 35 USC 103(a) as being unpatentable over Adams, in view of Kirk and Weisstein, "CRC Concise Encyclopedia of Mathematics", pages 1045-1049, 1999 (hereinafter referred to as Weisstein). The claims 4 and 14 depend from now presumably allowable claims 1 and 12 and are therefore also believed to be in allowable condition for the reasons set forth above. Accordingly, this rejection under 35 USC 103(a) is now believed to be overcome.

#### 5. Allowable Claims

Sections 40-43 on pages 15-16 of the Office Action indicate that claims 23 and 25 would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims. The undersigned appreciates this indication of allowable subject matter.

#### 6. Fee Authorization And Extension Of Time

No additional fee is believed to be required for this amendment or response, however, the undersigned Xerox Corporation attorney hereby authorizes the charging of any necessary fees, other than the issue fee, to Xerox Corporation

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Deposit Account No. 24-0025. This also constitutes a request for any needed extension of time and authorization to charge all fees therefor to Xerox Corporation Deposit Account No. 24-0025.

#### 7. Conclusion

In view of the foregoing remarks, reconsideration of this application and allowance thereof are earnestly solicited. In the event the Examiner considers a personal contact advantageous to the disposition of this case, the Examiner is hereby requested to call Attorney for Applicant(s), Thomas Zell.

Respectfully submitted,

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